LINK OPERATIONS & MAINTENANCE SATELLITE FACILITY

Task 5.3A

Link OMSF Corridor Analysis

SOUNDTRANSIT
CENTRAL PUGET SOUND
REGIONAL TRANSIT AUTHORITY

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MEMO/REPORT PURPOSE

This technical memorandum documents the corridor analysis for locating the future ST2 Link light rail OMSF. It builds on analysis of the O&M facility needs of the Core Light Rail System Expansion documented in Task 2, but focuses more on the immediate needs of the Sound Transit ST2 planned light rail extensions north to Lynnwood, south to Kent/Des Moines, and east to Overlake Transit Center.

ST2 PLAN ASSUMPTIONS

In 2011 Sound Transit conducted a system wide operations analysis for the implementation of the ST2 light rail system expansion. The result of this effort was:

- Operations Plan – Lynnwood to Kent/Des Moines and Overlake Transit Center (June 2011)
- Link Light Rail Fleet Management Plan (June 2011)

The updated ST2 operating plan, assuming the revised south corridor minimum operating segment terminus at Kent/Des Moines, is estimated to require 180 light rail vehicles or 118 more than the current fleet of 62 vehicles to meet the ridership demand associated with the 2023 system expansion. As depicted in Figure 1, the ST2 Link Light Rail Operating Plan assumes 8 minute peak headways (7.5 trains per hour on average) for the two trunk lines from Lynnwood to Kent/Des Moines and Lynnwood to Overlake Transit Center.

Figure 1: ST2 Link Light Rail Operating Plan

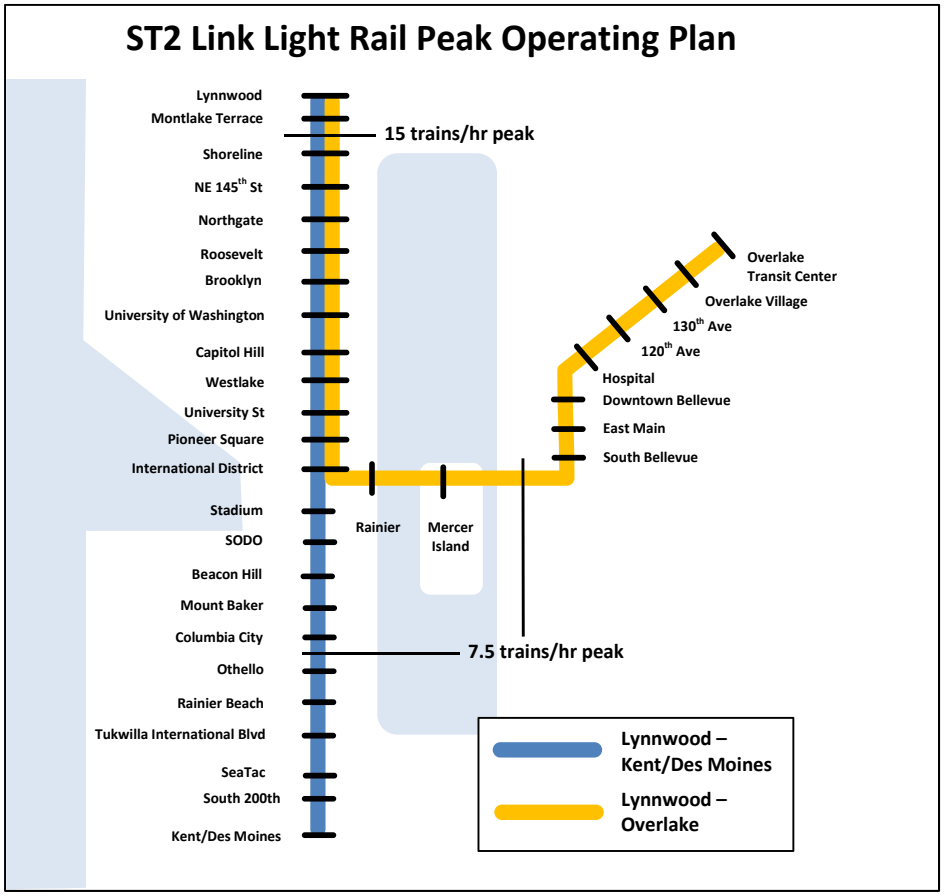


Table 1 presents the fleet requirements as each extension becomes operational. Note that in 2021 the full capacity of the Forest Street facility will be reached (full capacity is 104 vehicles).

Table 1: ST2 Fleet Growth through 2023

Light Rail System	Fleet Requirement
Westlake to Airport (2009)	35 vehicles
University of Washington to South 200th (2016)	62 vehicles
Northgate to South 200th (2021)	102 vehicles
ST2 – Lynnwood, Overlake TC, Kent/Des Moines (2023)	180 vehicles

Upon opening the ST2 extensions north, south and east, the fleet requirement grows to 180 light rail vehicles. The ST2 operating plan defines the 180 light rail vehicle fleet requirement to meet 2030 ridership demand and vehicle loading criteria. Table 2 shows the operating and fleet requirements.

Table 2: ST2 Operating and Fleet Requirements

	Lynnwood-Kent Des Moines	Lynnwood-Overlake TC	Combined
Peak Headway (min)	8	8	4
Service + gap vehicles	80	76	156
Spare cars (~15%)	12	12	24
Fleet Requirement	92	88	180

The two distinct operating lines for ST2 provide a fairly even allocation of the fleet between the north-south line (Lynnwood to Kent/Des Moines) and the north-east line (Lynnwood to Overlake Transit Center). Maintenance and storage needs for the 180 vehicle fleet, as stated earlier, exceed the capacity of the Forest Street OMF by 76 vehicles (rounded to approximately 80 vehicles for facility planning and design purposes). Accommodation of this need requires either an expansion to the Forest Street OMF or development of an additional facility. The north-south line is best served by the current Forest Street Operations and Maintenance Facility (OMF). The north-east line could be served in the following ways:

- Expansion of the existing Forest Street OMF
- Construction of a OMSF along the Lynnwood Link Extension between Northgate and Lynnwood
- Construction of an OMSF along the East Link Extension
- Construction of an OMSF south of Forest Street

Operations Plan – Lynnwood to Kent/Des Moines and Overlake Transit Center (June 2011)

The Link Light Rail Operations Plan develops fleet requirements to meet peak one hour ridership demand based on a design load factor of 148 passengers per vehicle, or twice the seated capacity per vehicle. The methodology used is appropriate and consistent with industry practice. The only comment

of note regarding the document is that it builds the fleet by extension, including the assumption that East Link will open in 2021. Since the publication of the plan the opening of East Link has shifted to 2023, the same year as the planned opening of the Lynnwood and Kent/Des Moines extensions. Additional demand growth in 2023, as opposed to 2021, is not expected to alter the fleet requirements or ability of the fleet to meet the desired design load factor.

There is always a possibility that opening year ridership demand will exceed previous forecasts. Over the past 20 years it has not been uncommon for a transit property to underestimate the demand for light rail service in the opening year and forecast year. When this happens, agencies sometimes expand fleet by exercising vehicle manufacturer contract options.

It is appropriate and consistent with FTA and industry practice to base light rail vehicle fleet procurements on satisfaction of the design load factor and is partially why agencies include options for more vehicles in vehicle procurement contracts. A problem arises however when increased vehicle demand outpaces the storage capacity of the vehicle maintenance yards. By planning for the exact number of vehicles required based on ridership estimates and sizing the OMSF for that specific number, the potential exists to lack a storage capacity contingency for flexibility in the event additional vehicles are needed.

An OMSF facility in conjunction with the existing Forest Street OMF (or an expanded Forest Street OMF that operates as the only base) must be capable of supporting the ST2 system build-out in its entirety, in terms of both storage capacity and maintenance throughput. This capability must include sufficient storage capacity of LRVs and the heavy and light maintenance functionality needed for the ST2 LRV fleet.

While the methodology and assumptions used appear to be prudent in estimating the light rail vehicle (LRV) revenue fleet required to support ST2 service levels, there are a number of operational unknowns that point toward the potential need for an added margin or “contingency” of additional facility capacity for both storage and maintenance throughput—in the event that a larger than anticipated fleet is ultimately required. These unknowns include (but are not limited to) the actual need for gap trains to maintain service quality and on-time performance and the actual alignment and operating configuration of the Link extensions. An additional site design capacity contingency of 5% would not be unreasonable.

Link Light Rail Fleet Management Plan (June 2011)

As presented in the Sound Transit Rail Fleet Management Plan (RFMP), the objectives of the plan are to:

- To document the method used to determine fleet size requirements for the proposed full Link Light Rail system following completion of the Sound Transit 2 (ST2) plan. It also gives information about interim implementation stages;
- To demonstrate that Sound Transit has identified and put in place the necessary maintenance philosophy and maintenance facilities to ensure that the enlarged light rail fleet will provide reliable services for the projected life of the vehicles;

- To demonstrate the need for fleet growth, with ridership expansion over the period 2016 to 2030; and
- To satisfy the requirements of FTA Guidance on Rail Fleet Management Plans, dated September 2, 1999.

Of these objectives, the second one related to maintenance philosophy and maintenance facilities, is of most relevance to the Link light rail OMSF project. The methodology used to determine fleet size requirements for completion of the ST2 Plan, demonstrated need for fleet growth to 2030, and satisfaction of FTA Guidance on Rail Fleet Management Plans requirements, have been reviewed and found to be satisfactory.

After the review of the RFMP, and interviews with ST Operations and Maintenance personnel, it is validated that the operation of the planned Link light rail (LLR) extensions will require a rail car fleet of approximately 180 vehicles.

Conclusion

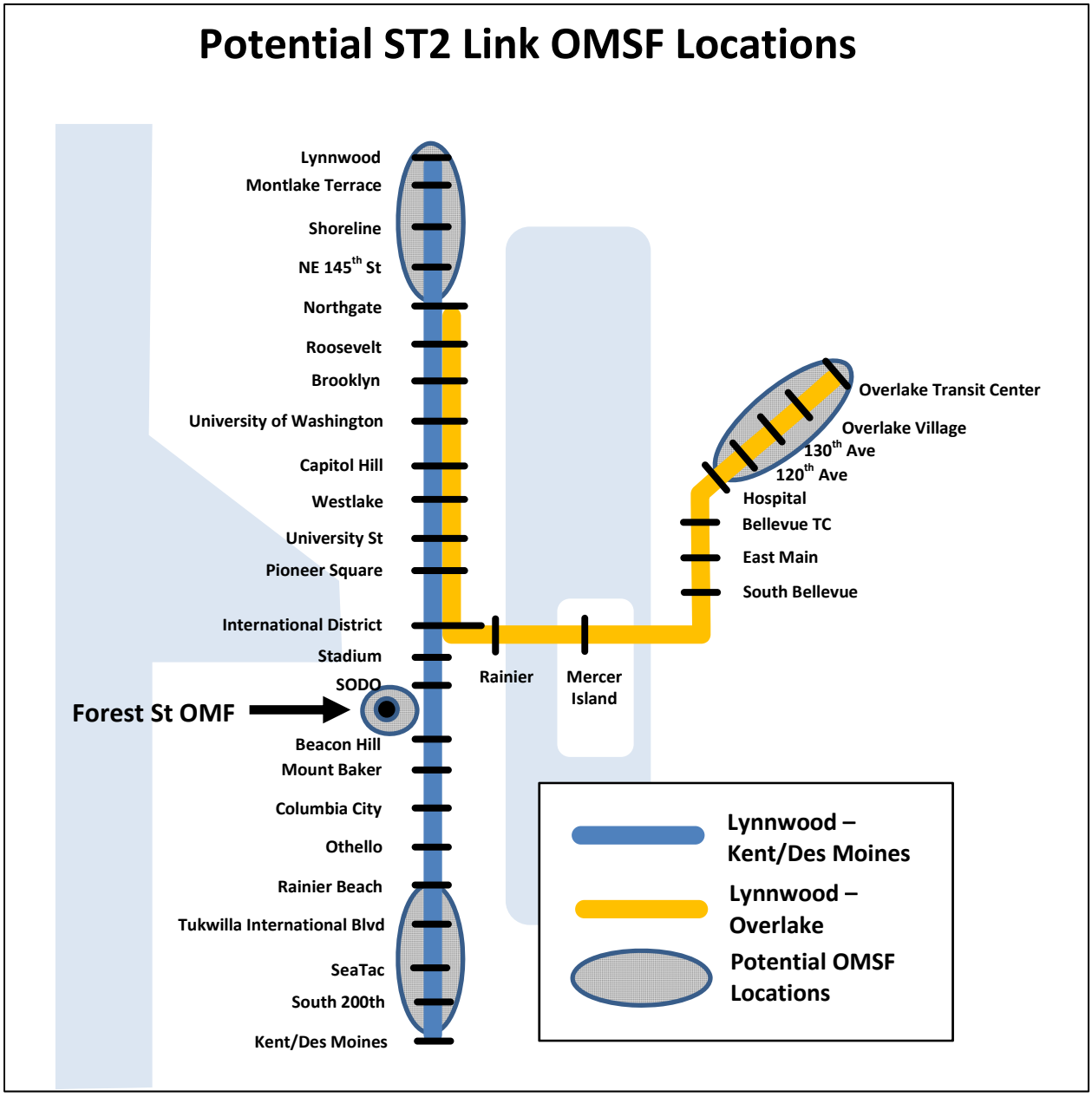
The change in Link light rail OMSF project delivery schedule has not affected the major conclusions of the Light Rail Operations Plan and the Rail Fleet Management Plan developed in 2011 to address the ST2 system wide operations requirements.

LINK OMSF POTENTIAL CORRIDOR OPTIONS

The future ST2 Link OMSF is required to meet the service and light rail expansion elements included in ST2. Like the light rail extensions, the ST2 Plan made assumptions of facility size and location based on the best information available leading up to adoption of the plan in 2008. Since that time, several of those assumptions have been more fully explored and in some cases adjusted based on the availability of additional information and analysis.

Three corridors were considered for their potential to serve as a location for the OMSF: North, South, and East as shown in Figure 2. The North corridor includes areas north of the junction that is south of the International District Station (IDS), where the East Link line will enter the Downtown Seattle Transit Tunnel, to the terminus of the light rail line in the City of Lynnwood, with potential sites considered between Northgate and the City of Lynnwood. The South corridor includes areas south of the junction south of the IDS to the terminus of ST2 planned service in Kent/Des Moines. The East corridor includes areas that extend east from the junction south of the IDS along the East Link line to the Overlake Transit Center.

Figure 2: Potential ST2 Link OMSF Corridor Locations



The following sections generally present the opportunities and constraints of locating the ST2 Link OMSF in each light rail extension corridor.

Assumptions

- The site is adjacent to, or within close proximity to, the existing Central Link or along a planned ST2 extension.
- All OMSF functions would be provided at any of the sites.
- At a minimum the facility must accommodate the extra 80 vehicles beyond the capacity of the existing Forest Street OMF.

- Optimally, a north or east OMSF would accommodate the full 88 vehicle requirements of the Lynnwood to Overlake Transit Center line.
- For future contingency planning, a north or east OMSF would also accommodate (or be expandable to accommodate) the 10 additional vehicles that will be required once the Redmond Link Extension is approved in the future.[12]

Constraints

- The constraining point on the entire system is the Downtown Seattle Transit Tunnel – primarily the lack of turnaround opportunities. Failure of the line north of IDS allows limited ability to supplement service from an OMSF in the north corridor. The significance of this has not been modeled, but is not believed to be a fatal flaw or have potential for long-term operating disruptions.
- Trains deploying from a north facility to the east travel approximately 30 miles to get to the turnaround at Overlake Transit Center every morning, adding additional deadhead (non-revenue) time and expense to the system.
- Trains deploying from a southern facility would be required to travel up to 17 miles to reach the junction of the north/south line and north/east lines south of the International District Station (IDS) before traveling east to start service in Redmond which would add additional time and expense to the system.
- Morning peak period deployment of the entire fleet from the south corridor creates operational constraints as vehicles do not have the ability to make a direct connection or movement between the east and south corridors; meaning that all trains making this movement must first travel north to a potential turnaround track at IDS or to the pocket turnaround track at Northgate before coming back south and to service the east corridor line.
- The entire fleet of 180 vehicles cannot be deployed from an expanded Forest Street OMF due to the limited capacity of the single main line.
- Additionally, any facility south of the MLK segment (between Mt Baker and Rainier Beach) is constrained during morning deployment by the inability to exceed a 6 minute headway in that section – the time it takes to deploy the number of trains required, exceeds the AM peak period.
- Irrespective of location, deployment of the entire ST2 morning fleet from the south corridor will impact the ability to maintain the needed 4 hour maintenance window from 1:00 AM to 5:00 AM.
- With express regard to expanding the Forest Street OMF, current Board policy prohibits expansion of the facility (R99-34).

[1] Note: Link light rail extensions to Everett and Tacoma will require an additional 96 vehicles, exclusive of the additional 10 for the Redmond extension. Given track geometry requirements and other site considerations, it is believed to be more economical to provide for the additional 10 Redmond vehicles at the ST2 OMSF than it is to provide full capacity now for build out to Everett and Tacoma.

[2] Sound Transit, "Task 2.3A, Core Light Rail System Plan Review," September 2012.

North Corridor Review

The Lynwood Link Extension project will study light rail alignment alternatives in the Draft EIS within the I-5 corridor. This decision limits the location of a potential OMSF to areas adjacent, or in close proximity, to I-5 and the planned Link light rail extension.

There is no fatal flaw from an operational standpoint associated with a north corridor facility, however as described in the constraints section above, trains deploying from a north facility to the east travel approximately 30 miles to get to the turnaround at Overlake Transit Center every morning, adding additional deadhead (non-revenue) time and expense to the system.

Build out of the core light rail system envisioned in the Long-Range Plan will require a facility in each corridor to efficiently service each operating line (see Technical Memorandum 2.1A).

South Corridor Review

Two alternative scenarios exist in the south corridor for the expansion of vehicle storage and maintenance: (1) build a second facility south of Forest Street: and (2) expand the existing Forest Street Facility. An operational analysis has determined that locating a second facility along the south line would not meet the operational needs of the system for reasons cited in the constraints section above and summarized below:

1. An OMSF located in the south corridor could not dispatch the required number of trains to both the north/south and north/east lines without exceeding the time required to make peak service roll out.
2. Trains deployed from a southern O&M facility are required to travel up to 17 miles to reach junction of the east line south of the International District Station (IDS) before traveling east to the Overlake Transit Center to begin westbound morning peak service.
3. The time window required for overnight track and systems maintenance (1:00 AM to 5:00 AM) requires that no trains be on the track during these times and the dispatch of all trains from one corridor would seriously impede this necessary maintenance window.
4. A facility south of the Rainier Valley is constrained by the restriction that trains not exceed the 6-minute headway in that section, which would result in the inability for trains to meet the 6:00 am peak period roll-out.
5. Morning peak period deployment of the entire fleet from the south creates operational constraints for trains to make a direct connection or movement to the east line without first traveling north to a potential turnaround track at IDS or to the pocket track north of the Northgate Station.
6. If the entire fleet of 180 vehicles were stored at an expanded OMF site, a system failure could result in the entire fleet being unable to make morning peak deployment.
7. Current Board policy prohibits expansion of the existing OMF (R99-34), and would require a Board action to change.

East Corridor Review

Extension of light rail from Overlake Transit Center to downtown Redmond as part of future light rail planning efforts will require 10 more vehicles, and in anticipation of that future requirement, an eastside Link light rail OMSF would be the most appropriate place to store and maintain those vehicles, eliminating the need for an additional eastside facility to serve the Redmond extension in the future. However, this added contingency capacity could be added to a north corridor facility as well.

If the ST2 OMSF is located in the east corridor, and is capable of accommodating expansion for the Redmond extension, a third OMF would eventually be required in the north corridor as the core light rail system is built out. If the ST2 OMSF is located in the north corridor, a third facility would eventually be needed in the east corridor.

On the rare occasions when the I-90 Bridge is shut down, light rail service could still operate between Mercer Island and Overlake Transit Center with an eastside OMSF.

Conclusion

As stated previously, establishing the ST2 Link light rail OMSF in the south corridor, or expanding the existing Forest Street OMF to accommodate the full 180 vehicle ST2 fleet, has potential to impact operational cost, reliability and efficiency. The most promising corridors for the ST2 Link light rail OMSF are the north and east corridors. Prior to extending Link light rail to Everett and Tacoma, a facility in the north corridor has potential to generate excessive operating costs. Once the long range plan extensions are built, these costs become negligible as the third facility would be expected to be built in the east corridor. The east corridor has the best potential for operational effectiveness (cost, reliability and efficiency) for the term of the ST2 operating plan. The east corridor is the most promising of the three potential Link OMSF corridors. The north corridor is viable. The south corridor is not viable for locating the ST2 OMSF.